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Distribution and Control of the Japanese Beetle in Ohio

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DISTRIBUTION AND CONTROL OF THE JAPANESE BEETLE IN OHIO

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The Japanese beetle, *Popillia japonica* Newm., was found for the first time in Ohio in 1931 when a few beetles were taken in traps in Cleveland and in Columbus. Since that time this insect has been taken in one or more new locations in the State each year and, by the end of the 1949 season, was found at one or more points in 47 of the 88 counties.

Location of the original infestations with dates of the first finds, number of points within the area, and the number of beetles taken is shown in Table 1.

At the present time the range of the Japanese beetle in Ohio falls into two categories. The one consists of several areas in which the beetle is present at nearly all points, while in the other the beetles

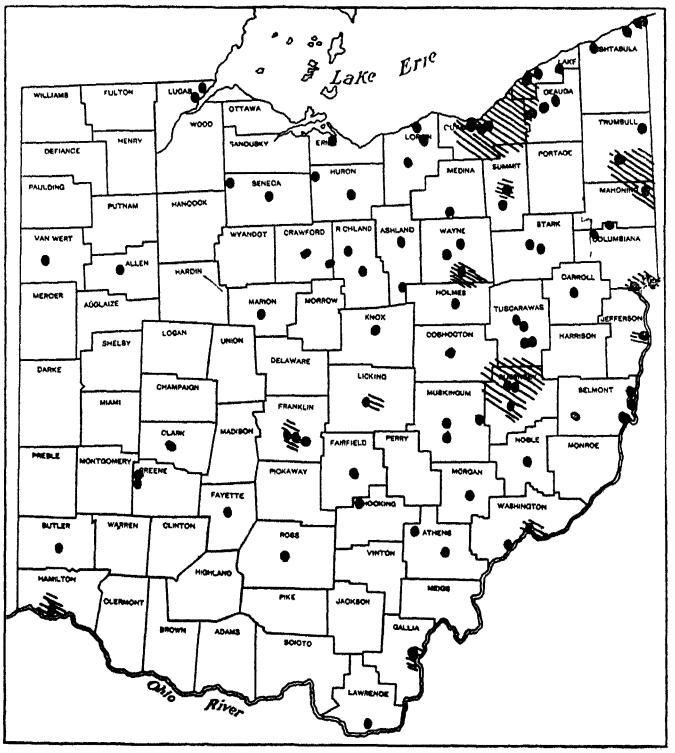

Figure 1. The black dots show the location of the original Japanese beetle finds from trapping and scouting and the shaded areas show the spread of the insect.

occur in small numbers in localized areas of various sizes separated by extensive areas free from the insect. In areas where the insect found conditions suitable for its development, it has accumulated

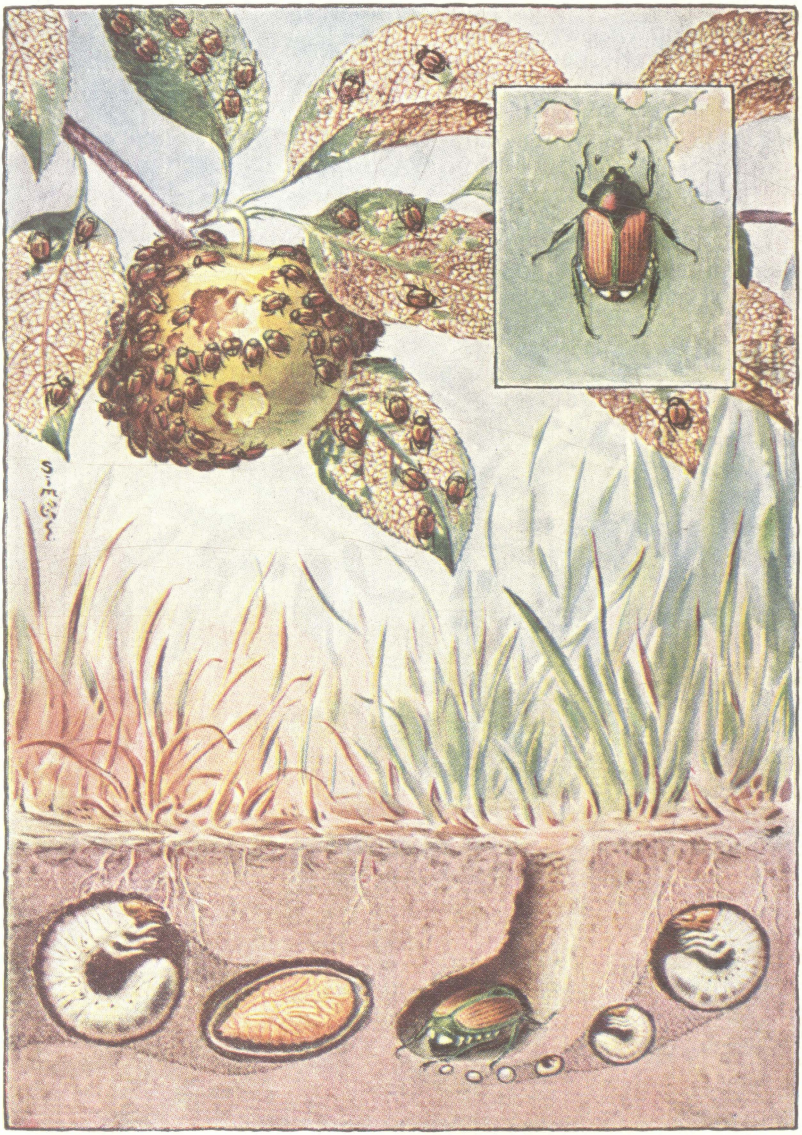

Figure 2. Stages of the Japanese beetle. Adult beetles feeding on fruit and leaves, about one-half natural size. Insert, adult beetle, about twice natural size. Below ground, left to right, full-grown grub, pupa, adult beetle, eggs, and developing grubs, all about twice natural size. (Courtesy of the U. S. Department of Agriculture).

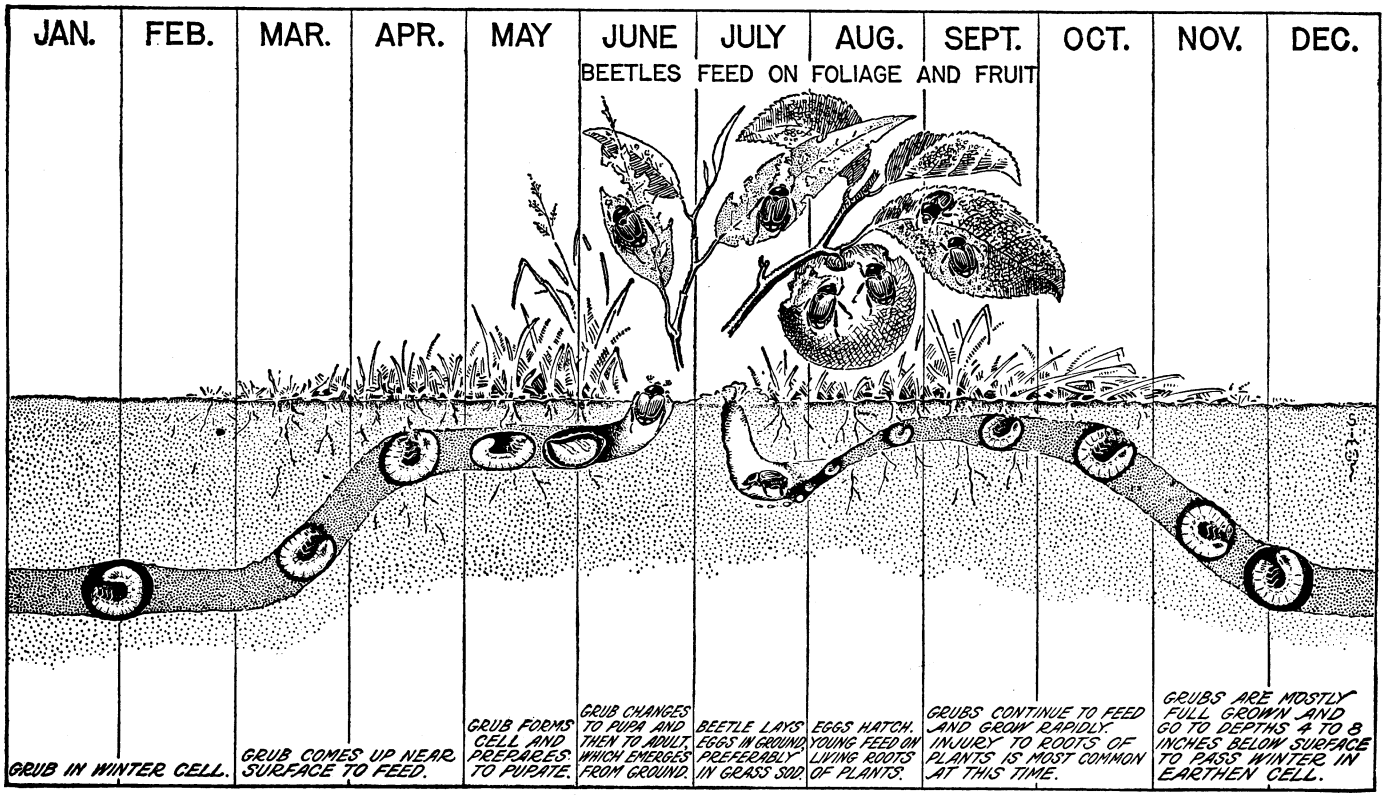

FIGURE 3.—Diagrammatic representation of the seasonal life cycle of the Japanese beetle.

(Courtesy of the U. S. Department of Agriculture)

and spread outward in all directions until the total area covered by its natural spread amounts to 1,235 square miles in the 12 areas of general accumulation. These two types of distribution are shown graphically in Figure 1.

Figure 4. Sod easily rolled back to expose the grubs just beneath the surface.

PROBLEM AREAS

From the data in Figure 1, it may be seen that the Japanese beetle has spread out from the original points of infestation in 12 different places in the State. Of this number, eight locations have experienced serious damage to turf and foliage.

In Bratenahl, a part of Greater Cleveland, the insect continued to increase in numbers from 1939 to 1943 causing considerable damage to turf and foliage during this time. Following the years of 1943, 1944, and 1945, which were deficient in rainfall during the month of July, there was a marked decrease in the number of beetles for the years of 1944, 1945, and 1946. With the return of normal rainfall during July of 1946, 1947, and 1948, there has been a gradual increase in the number of beetles in that area. There has also been a marked increase in beetle numbers in areas 3 to 5 miles

from the original point of infestation and in these areas considerable damage is being done to turf and foliage each year.

The same situation occurred in the Youngstown and North Salem areas. The infestations in Newark and Columbus were on the increase in 1945 and have continued to increase in size without causing serious damage to turf and foliage during this period. The infestation in Wellsville, Akron, Steubenville, and Marietta has developed in the past two years. In these areas, the beetles have caused considerable damage to foliage while the grubs have ruined much turf. In the Gallipolis area there has been a consistent spread of the beetles for several years. However, the increase in numbers at any one point within the area has not developed because it has been treated yearly with insecticides around all points where the beetles were taken. The latest potential threat developed in Cincinnati. When the insect was first found along the northern edge of the city, it had already accumulated in sufficient numbers to cause some damage to turf and foliage. The trapping program in 1949 has indicated that it has spread over a large portion of the city and its suburbs.

DESCRIPTION OF THE INSECT

The adult beetle is about one-half inch long and one-fourth inch wide. The head, thorax, and abdomen are metallic green in color while the hard outer wings are coppery-brown. There are two tufts

Figure 5. Blow hole in the golf course at Bratenahl. This is the result of a high grub population in 1942 and 1943 which killed the grass. The wind blew the dead turf away after being chopped up by the mower. Low rainfall during the summer of 1943, 1944, and 1945 prevented weeds from growing.

of white hair on the abdomen just behind the wing covers and five tufts along each side of the body (Fig. 2).

The eggs are nearly spherical in shape, one-sixteenth to one-eighth inch in diameter, and are white when first laid changing to cream colored before hatching.

The larva or grub, when fully grown, is about one inch long and white to greyish-white in color with a reddish-brown head. It is usually found just beneath the soil surface lying in a crescent shaped position.

The pupa is cream colored, bobbin shaped, and about one-half inch in length. It is from this stage that the insect transforms into the adult beetle.

LIFE HISTORY

The eggs of the Japanese beetle are laid principally in closely cropped turf, such as is found in lawns, golf courses, cemeteries, and pastures. In some years, when the rainfall is low during the month of July, a large number of eggs may be laid in tall grassy areas. The eggs, which are laid in batches of one to four at a time and about two and one-half inches beneath the soil surface, hatch in about ten days. The tiny larvae start to feed immediately upon the humus

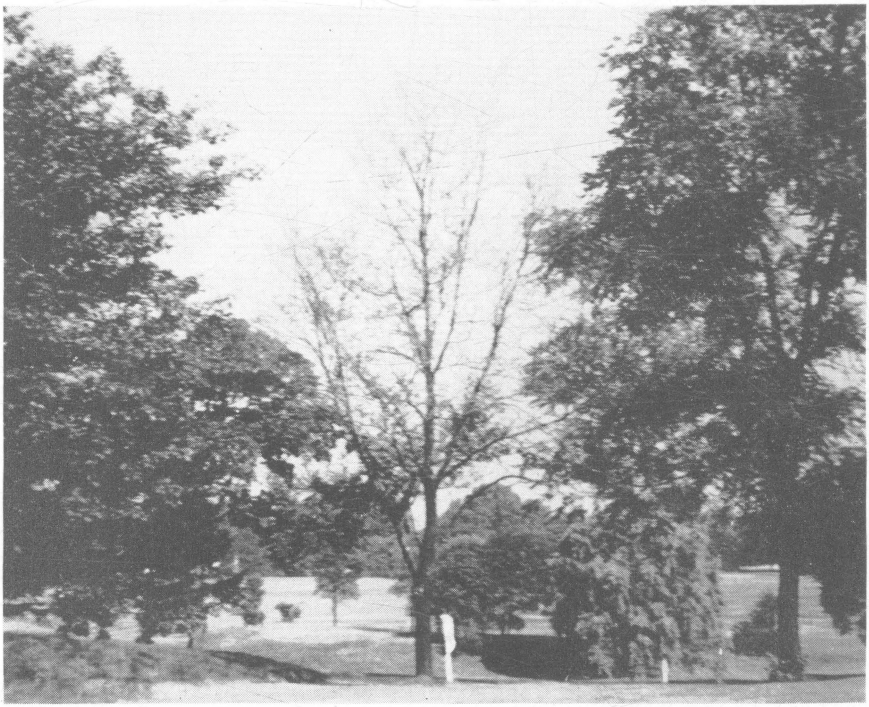

Figure 6. Elm tree partially defoliated by Japanese beetle.

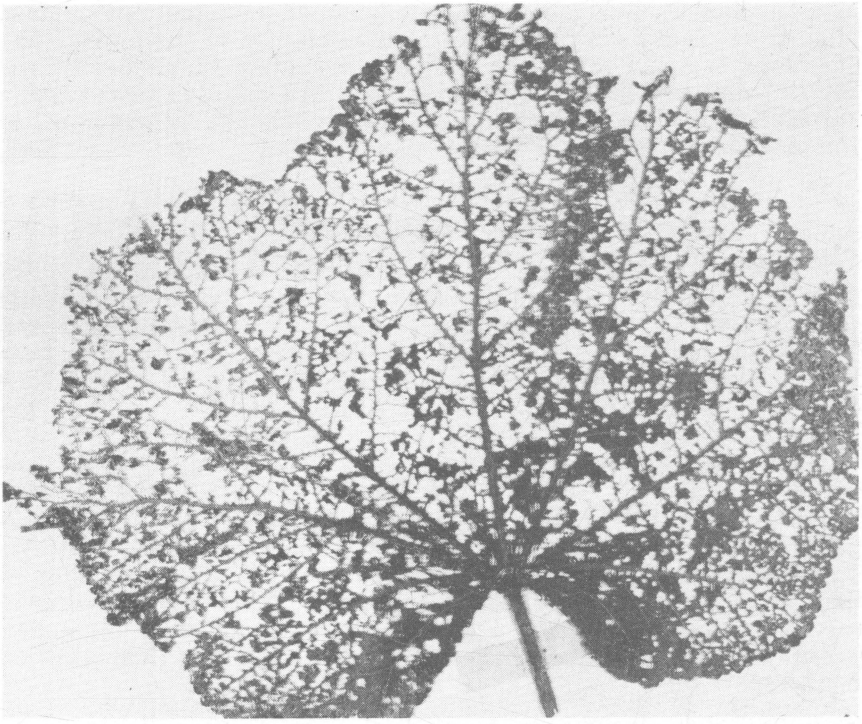

Figure 7. Hollyhock leaf skeletonized by Japanese beetle.

in the soil and on the roots of various plants. As the larvae increase in size, they work their way up close to the surface where they continue to feed upon the roots of grasses causing it to die out in small patches. By the latter part of October or upon the approach of cold weather, the grubs gradually work their way down into the soil where they pass the winter. The depth to which they migrate varies from six to fourteen inches. This depth, undoubtedly, varies with the temperature, soil type, and soil moisture. As soon as it warms up in late March or early April of the following year, the larvae again approach the soil surface to continue their feeding. In the latter part of May, they change into the pupal stage with the adults appearing late in June. The seasonal behavior of the insect is shown in Figure 3.

DESCRIPTION OF DAMAGE

The larvae damage turf by cutting the grass roots, causing the grass to die out in small patches or larger areas. When the grubs occur in numbers of ten or more per square foot, the turf can be rolled back very easily exposing the grubs underneath (Fig. 4). Low rainfall during June and July, following a high grub population in one location for a year or more, may cause the turf to be blown away leaving an area bare of any vegetation, as shown in Figure 5.

The beetles feed on the leaves, flowers, and fruit of a large number of plants, confining their attack chiefly to the outer parts of plants exposed to bright sunlight. In severe infestations, the beetles may defoliate large trees (Fig. 6). The adults eat away the green tissue between the veins, leaving only the lacy network of the leaf structure (Fig. 7).

NATURAL FACTORS WHICH AFFECT THE BEETLE POPULATION

Disease of the larvae. A bacterial disease, *Bacillus popilliae* Dutky, commonly known as the milky disease of the Japanese beetle larvae, was first introduced into Ohio in 1941 at Cleveland and Youngstown. This disease, which was found early in the Japanese beetle investigations affecting 50 percent of the larvae in New Jersey, is now playing an important role in the control of this pest in the eastern states. In order to hasten the build up of this disease in Ohio, an extensive program of propagation and distribution was carried on for five years. During that time the spores that were produced were distributed in all of the heavily infested areas.

In 1949, when the annual survey was made during the month of June, it was found that this disease was accounting for from 4 to 70 percent of the larvae in the different areas. This variation was in direct correlation with the length of time the spores were in the area, the density of larval population, and the rate of application of the spore dust.

While making a larval survey in the Marietta area in August of 1949, a large number of diseased grubs were found on the golf course near Marietta. In several spots on the course, fifty percent of the grubs were found diseased. Since the closest application of spore dust had been made 60 miles away, it would seem logical to conclude that birds were responsible for bringing the disease to this area.

Parasites. Three parasites that have been brought in from Asia have now been released in Ohio. Two of these are wasp-like insects, one emerging in the spring, the other in the fall. The third is a fly.

The spring emerging wasp-like parasite that feeds upon the Japanese beetle larvae has been released in 27 different locations in 9 different cities or townships. while the fall emerging wasp-like parasite has been released in 3 different locations in 3 different cities. It has been definitely determined that the spring parasite has become established in three locations while the other locations and those of the fall parasite have not been checked.

The third parasite, which resembles the common house fly in size and general appearance, is parasitic upon the adult beetle. This parasite has been released in only one location in the State and so far it has not been determined whether it has become established.

Birds and other animals, such as skunks and moles, consume a large number of grubs. In one area it was estimated that birds were responsible for reducing the population from 31 grubs per square foot in April to 14 grubs per square foot in June.

CONTROL MEASURES

Since the Japanese beetle is destructive in both the adult and larval stages, the control measures may be directed toward the destruction of the larvae in the soil and destruction of the adults upon the foliage.

Control of the larva or grub. Turf can be made practically immune to injury by the grubs by applying DDT, chlordane, or lead arsenate. These materials can be applied at any time the ground is not frozen.

DDT should be applied to the ground at the rate of 25 pounds of the technical material per acre. This means that 1.2 pounds of a 50 percent DDT powder should be applied to 1000 square feet or 50 pounds per acre. To simplify the distribution and to obtain uniform coverage, the material can be mixed with about 20 pounds of sand or milorganite and broadcast by hand or with a fertilizer spreader (Fig. 8). When DDT is applied as a spray, it should be used at the rate of 2 ounces of 50 percent wettable powder in 3 gallons of water for each 100 square feet of surface area. In small areas the treatment can be made with a sprinkling can (Fig. 9). In Figure 10 is shown a method that can be used for covering larger areas. A single treatment of DDT will remain effective for at least 5 years.

Figure 8. Applying insecticide to turf with a hand fertilizer spreader.

Chlordane should be used at the rate of 10 pounds of actual material per acre. If a 40 percent chlordane powder is used, it should be applied at the rate of 10 ounces to each 1000 square feet or 25 pounds to the acre. If the material is applied as a spray, 10 ounces of the 40 percent wettable chlordane should be mixed with 25 gallons of water for treating each 1000 square feet of area. Chlordane has given excellent control of the grubs for four years.

Figure 9. Applying small quantity of insecticide with a sprinkling can.

Lead arsenate can be used at the rate of 10 pounds to each 1000 square feet. The method of applying this material is the same as for DDT and chlordane. This material is gradually being replaced with DDT and chlordane because it is more costly.

Control of the beetles. The foliage, fruit, and bloom of plants can be protected against the ravages of the adult by applying an insecticide which is most suitable for the different situations.

DDT is the most effective insecticide for the control of the beetles. This material is sold on the market in many forms for several different purposes, but the best results have been obtained when the 50 percent wettable powder has been used. The spray can be made up as follows:

Amount of water	Amount of 50 percent DDT necessary
1 gallon	2 tablespoonfuls
5 gallons	½ cup
50 gallons	1 pound

DDT may also be applied as a 5 percent dust. When dust is used, it will be necessary to apply it more often than the spray because it does not stick to the plants as well as the liquid applications.

Although DDT is very effective for killing the beetles, it should not be used on small fruits until after the fruit has been picked or on other fruit later than 2 to 3 weeks before picking.

Toxaphene is another insecticide that has given good control of the beetles when it is mixed at the rate of 1 pound of a 50 percent wettable powder or 2 pounds of a 25 percent wettable powder in 50 gallons of water. To make smaller amounts of spray material, toxaphene can be mixed with water in the same proportions as recommended for the DDT dilutions.

Rotenone bearing materials, such as powdered derris or cube, are of value in killing and repelling beetles from small fruits or on other fruits that should not be treated with DDT or toxaphene. This material should be mixed with water as follows:

Amount of water	Amount of rotenone bearing powder
1 quart	1 heaping tablespoonful
5 gallons	1 cup

Figure 10. Large acreages can be treated in a short time with a unit of this type.

Lime applied either as a spray or dust is of value in repelling beetles from plants where it is not desirable to use poisons.

Handpicking may give considerable protection when there are only a few plants to be protected.

Table 1. Location of original Japanese beetle finds by counties and cities or townships with date of find, number of points within area, and the number of beetles taken.*

County	City or Township	Date of first find	No. of locations	No. of beetles taken
Allen	Lima	1943	1	1
Ashland	Ashland	1944	10	23
	Loudonville	1945	1	3
Ashtabula	Ashtabula	1937	7	129
	Conneaut	1935	2	2
	East Conneaut	1941	28	91
	Geneva	1946	7	7
Athens	Athens	1940	1	1
	Nelsonville	1942	2	2
Belmont	Barnesville	1939	3	3
	Bellaire	1937	1	1
	Bridgeport	1939	1	1
	Martins Ferry	1939	9	13
Butler	Hamilton	1945	1	1
Carroll	Carrollton	1938	3	3
Clark	Springfield	1945	1	1
Columbiana	Butler Twp.	1942	1	51
	East Liverpool	1934	1	2
	Salem	1935	1	1
	Wellsville	1946	1	several
Coshocton	Coshocton	1937	15	28
Crawford	Bucyrus	1940	3	3
	Crestline	1942	11	20
Cuyahoga	Cleveland	1931	1	1
	Cleveland Heights	1937	1	1
	East Cleveland	1937	1	1
Erie	Sandusky	1938	1	1
Fairfield	Lancaster	1935	2	2
Fayette	Washington C. H.	1933	1	1
Franklin	Columbus	1931	5	5
	Bexley	1938	1	1
	Brice	1949	1	1
Gallia	Gallipolis	1937	10	12
Geauga	Bainbridge	1949	1	1
	Chardon	1948	2	2
	Chesterland	1949	1	2
	Munson Twp.	1942	1	4
Greene	Fairfield	1948	1	2
	Osborne	1949	3	4

* The original infestations were found through the cooperative trapping program of the State Department of Agriculture and the Federal Bureau of Entomology and Plant Quarantine.

Table 1. (Continued)

Guernsey	Cambridge	1939	2	4
	Kimbolton	1939	1	1
	North Salem	1939	13	694
Hamilton	Cincinnati	1937	1	1
Hocking	Good Hope Twp.	1942	1	167
Holmes	Millersburg	1941	1	1
Huron	Bellevue	1942	67	218
	Norwalk	1940	1	1
	Willard	1943	1	1
Jefferson	Steubenville	1932	4	5
Knox	Mt. Vernon	1942	4	5
Lake	Mentor	1941	2	47
	Painesville	1946	20	32
	Perry	1947	2	5
Lawrence	Fayette Twp.	1945	1	1
Licking	Newark	1938	12	155
Lorain	Elyria	1939	2	2
	Lorain	1942	2	2
	Wellington	1944	1	1
Lucas	Maumee	1946	1	1
	Toledo	1935	7	7
Mahoning	Youngstown	1933	1	1
Marion	Marion	1942	22	28
Medina	Seville	1939	2	21
Morgan	McConnelsville	1948	1	1
Muskingum	New Concord	1940	1	1
	South Zanesville	1941	22	1076
	Zanesville	1932	1	1
Noble	Caldwell	1941	1	1
Richland	Mansfield	1937	5	8
	Shelby	1944	1	1
Ross	Chillicothe	1935	1	1
Seneca	Fostoria	1943	2	2
	Tiffin	1942	1	1
Stark	Canton	1932	4	24
	Hills & Dales	1935	5	9
Summit	Akron	1935	2	2
	Barberton	1937	1	1
Trumbull	Kinsman	1946	1	1
	Warren	1945	6	45
Tuscarawas	Dennison	1938	42	396
	Dover	1938	25	144
	New Philadelphia	1942	1	2
	Uhrichsville	1938	2	2
Van Wert	Van Wert	1941	1	1
Washington	Belpre	1938	5	9
	Marietta	1935	4	12
	Marietta	1945	1	scouting
Wayne	Franklin Twp.	1946	1	scouting
	Orrville	1938	1	1
	Wooster	1935	2	2